A COMPARISON BETWEEN EFFECTS OF SPECIFIC BALANCE TRAINING PROGRAMME AND GENERAL BALANCE AND MOBILITY EXERCISE PROGRAMME FOR IMPROVING BALANCE IN ELDERLY POPULATION

By

(Reg. No . 27101809)

PADMAVATH COLLEGE OF PHYSIOTHERAPY

PERIYANAHALLI

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Under the guidance of

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Submitted in Partial fulfillment of the requirements for the

Degree of **Master of Physiotherapy**

From

The Tamilnadu Dr. M.G.R. Medical University,

Chennai

PADMAVATH COLLEGE OF PHYSIOTHERAPY

PERIYANAHALLI

DHARMAPURI

CERTIFICATE

This is to certify that the project entitled **"A COMPARISON BETWEEN EFFECTS OF SPECIFIC BALANCE TRAINING PROGRAMME AND GENERAL BALANCE AND MOBILITY EXERCISE PROGRAMME FOR IMPROVING BALANCE IN ELDERLY POPULATION "**

Submitted by the candidate

(Reg. No . 27101809)

is a bonafide work done in partial fulfillment of the requirements for the Degree of **Master of Physiotherapy** from

The Tamilnadu Dr. M.G.R. Medical University,

Chennai

Guide **Principal**

Viva-voce Examination held on _____

Internal Examiner **External Examiner**

DECLARATION

I hereby declare and present my dissertation entitled **"A COMPARISON BETWEEN EFFECTS OF SPECIFIC BALANCE TRAINING PROGRAMME AND GENERAL BALANCE AND MOBILITY EXERCISE PROGRAMME FOR IMPROVING BALANCE IN ELDERLY POPULATION""** the outcome of the original research work undertaken and carried out be me , under the guidance of **Mr. G. ANANDAN , M.P.T. , MIAP.,** Associate Professor , Padmavathi College of Physiotherapy, Periyanahalli, Dharmapuri , Tamilnadu.

I also declare that the material of this dissertation had not formed in any basis for the award of any other Degree previously from the Tamilnadu Dr. M.G.R. Medical University, Chennai.

(KAVI PRIYA . G)

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DEDICATED TO MY BELOVED

PARENTS , STAFFS

AND

LOVABLE FRIENDS

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I. INTRODUCTION

Biological functions decline with age. Deterioration of balance is a well documented hallmark of the ageing process. Poor balance is initially detectable in the sixth decade of life but then accelerates so that it becomes the rule rather than the exception by one's late eighties. Balance disturbances frequently cause elderly people to seek medical advice and admission to hospitals and residential homes. Impaired balance has been correlated with an increased risk for falls and a resulting increase in the mortality rate of elder people. Approximately 35% to 40% of generally healthy, community-dwelling persons aged 65 or older fall annually. Regardless or severity of the injury, sequel from even a benign fall can be devastating. A single fall often results in a fear or falling, which leads to a loss of confidence in one's ability to perform routine tasks, restriction in activities, social isolation, and increased dependence on others. The ensuing deconditioning, joint stiffness, and muscle weakness that result from immobility can lead to more falls and further mobility restriction.

Identification of significant risk factors is an important step towards fall prevention. Several studies have been performed among both home- living and institutionalised populations to define risk factors associated with falls. These risk factors have included both patient-related or "intrinsic factors" (e.g. advanced age, specific diseases, muscle weakness, gait disorders, mental status alterations, medications) and environment- related or "extrinsic" factors (e.g hazardous activities, time of day, environmental hazards)
A number of reviews have described balance performance as a highly complex set of overlapping sensorimotor, musculoskeletal psycho emotional, and perceptual functions. Abnormalities in any or, several of the links of this system render some elderly prone to falls. Because balance is an ill-defined and non unitary entity. it is not surprising that endeavors to improve it has met

with mixed success. Several fall prevention strategies have shown effectiveness in preventing falls and decreasing the risk of falling, although less is known about their effectiveness in preventing fall-related injuries. Exercise has been a key feature in reducing the risk for falls.

About 10%-25% of falls are associated with poor balance and gait abnormalities. Thus, balance training interventions have an important place in fall prevention. Literature on geriatric balance training is a merely of non-specific interventions characterized by conventional callisthenic (coordination) exercises, which often include aerobic or muscle-strengthening components. Many of these interventions have focused too heavily on simple maneuvers that are easier to quantify but that may not address adequately the varied needs of different individuals. Programs that are successful at improving balance took a more intensive approach to training.

However, because many different types of exercise programs were studied, it was impossible to determine which type was most effective.

Keeping this in mind this study was designed with the purpose of identifying the most appropriate balance training program for community dwelling elders with active lifestyle.

Two balance scales were used to assess the outcomes of both the interventions. They were the Timed Up and Go Test and the Berg Balance Scale. These scales have good reliability and validity which will be discussed in detail in the literature review chapter.

These scales have been selected for the study because:

1. They are very simple to administer.

2. They are quick and practical.

3. They are easy to be conducted in an Indian clinical setting.

4. The contents of these scales closely mimic the day activities and are easy for the patient to understand.

Statement of Question

Is a Specific Balance Training program better than a General Balance and Mobility exercise program for improvement of balance in community dwelling elderly population.

Research Hypothesis

Specific Balance-Strategy Training program is more effective in improving balance in elderly population as compared to the General Balance and Mobility exercise program.

Operational Definitions

Balance

Balance is a complex process involving the reception and integration of sensory inputs, and the planning and execution of movement, to achieve a goal requiring

an upright posture. It is the ability to control the center of gravity (COG) over the base of support in a given sensory environment.

Fall

A fall is defined as a sudden unintentional change in position, with or without loss of consciousness, causing the victim to land on the ground.

Timed Up And Go Test

Podsiadlo and Richardson (1990), modified the original Up and Go test, by timing the task of getting up from the chair, walking a distance of 3m, turning around and walking back to the chair. They proposed its use as a short test of basic mobility skills for frail community-dwelling elderly.

Berg Balance Scale

`The Berg Balance Scale is an easy to administer, safe, and simple and reasonably brief measure of balance for elderly people developed as a performance-oriented measure of balance in elderly individuals.

Balance Training Intervention

It is a set of exercise or training maneuvers that are administered to improve balance in the elderly. They are simple to administer and affordable as well as effective.

Limitation of the Study

A small sample size was one of the major limitation of the study. Also, most the participants belonged to the same community and were leading an active lifestyle. Thus, results obtained cannot be generalized for all population types.

Organization of Remaining Chapters

The remaining Chapters of this study are organized as follows. Chapter 3 deals with the Review of literature. Chapter 4 describes the procedures used in this study, including a description of subjects, group allocation, equipment used and method of data collection. Chapter 5 deals with data analysis. The results of the study are discussed in chapter 6. Chapter 7 contains the discussion of the result. Chapter 8 contains the conclusion of this study. References are given in Chapter 9 followed by Appendix.

II. REVIEW OF LITERATURE

This chapter deals with the view of the literature associated with postural control and its changes in the elderly, falls, risk factors and methods identifying falls. It also talks about the various strategies to prevent falls and improve balance.

Postural Control

Postural control requires keeping the center of gravity over the base of support during both static and dynamic situations. The body must be able to respond to translations of the center of gravity voluntarily imposed e.g. intentional movement, and an involuntarily or unexpectedly imposed movement e.g. slip, trip.

The sensory system that is, the visual, vestibular, and the somatosensory systems help in providing the individual with information regarding the body's position and trajectory in space and play a vital role in postural control. Vision helps to orient the body in space by referencing vertical and horizontal axes of objects around them. Components of vision that are clinically important include - acuity, contrast sensitivity, peripheral vision and depth perception. The vestibular system provides the central nervous system with information regarding head movememt and position. Vestibular input is used to generate compensatory eye movements and postural responses during head movements and helps to resolve conflicting information from visual images and actual movement. Proprioceptive input provided to the central nervous system by joint, tendon, and muscle receptors gives information regarding the motion of the body segments with respect to the support surface and motion of the body segments with respect to each other.

Central processing is the second major physiological component of balance control. Horak and Nashner's systems approach to balance control proposes that the central nervous system maps the location of the center of gravity and adaptively organizes its response to disequilibrium by preprogramming postural sensorimotor strategies. The preprogrammed strategies are based on the body's biomechanical constraints, available sensory information, the environmental context, and prior experience.

The effector component of balance constitutes the biomechanical apparatus through which the centrally programmed response must be expressed. Factors such as range of motion, muscle torque and power, postural alignment, and endurance can all affect the capacity for a person to effectively respond to a disturbance of balance Studenski et al and Whipple and colleagues determined that elderly fallers produce significantly weaker distal lower extremity torque than healthy older adults.

Effects of Ageing on the Substrates of Postural Control

The ageing process affects all components of postural control. Age - related changes occur in all of the sensory systems that sub serve the postural control. Changes in the visual system include reduced acuity, contrast sensitivity, depth perception, and dark adaptation. Also there is a loss of ability to discriminate low spatial frequencies. The vestibular system shows a progressive loss of labrynthine hair cells, vestibular ganglion cells, and nerve fibers, and there are age - related changes in the vestibulo - ocular reflex that are consistent with these peripheral anatomic changes. Age related in proprioception has also been demonstrated. With regard to cutaneous sensation, there is marked decrease in touch sensitivity, two - point discrimination, and vibration sense (low and high frequency), particularly in the lower limbs. Reduction in density and sensitivity of dermal mechanoreceptors, rigidity and

inelasticity of the surrounding dermal tissue, and peripheral nerve degeneration may all contribute to the decrease in cutaneous sensitivity.

Specific age related changes in the central nervous system such as loss of neurons and depletion of neurotransmitters, such as dopamine, and involutionary changes in the dendrite tree of motor neurons in the spinal cord disrupt the complex postural responses as well as educe the ability to compensate for age - related impairments in sensory input In addition, a general slowing of information processing, in conjunction with age-related decrease in nerve conduction velocity, would be expected to delay and further disrupt the generation of postural responses.

In the effector system, joint stiffness and loss of range of motion occur as a result of age-related degenerative changes in the joints themselves. Decline in muscle strength with age are associated with decreases in the size and number of muscle fibers. Increased stiffness in connective tissues in general contributes to age-related loss in joint range of motion and flexibility. In the ageing adult, subtle changes in any single component of the postural control system are or likely to be sufficient to cause postural instability. Redundancy in the system can guard subtle losses in any single component. Accumulation of mild deficits across multiple components of postural control, however may diminish the compensatory capacity of the system, leading to a lowered threshold for instability.

Falls in elderly

Everybody falls. Regardless of age, falling is a ubiquitous event experienced by all throughout life. Most falls, especially in children and young adults, are of minor consequence, are readily forgotten, and have no impact on subsequent function. Falls in the elderly, by contrast, are a major cause of morbidity and mortality.

A fall may result when the body's postural control systems fail to detect a displacement and do not reposition the center of mass over the base of support in time to avoid a "loss of balance".

In persons older than 85, approximately two thirds of injury related deaths are due to falls. It is estimated that 30% of community dwelling elders older than 65, 40% of those older than 80 years, and 66% of institutionalised elders fall each year. There is a greater-than-linear increase in the rate of falls between the ages of 60 to 65 and 80 to 85.

A fall often results in a fear of falling, which creates a loss of confidence restriction in activities, social isolation, and increased dependence on others. The ensuing deconditioning, joint stiffness, and muscle weakness that result from immobility can lead to more falls and further mobility restriction.

Risk Factors for Falls

Identification of significant risk factors is an important step towards fall prevention. Risk factors associated with falls can be classified as either intrinsic (host) or extrinsic (environmental). Demographic factors such as increasing age and female sex have strong evidence as a risk factor. Some studies, however, contradict an association between female sex and falls.

Altered drug metabolism in elderly individuals and improper doses of psychoactive medications such as antidepressents, tranquilizers, sedatives, hypnotics and psychotropic drugs may contribute to falls in elderly by decreasing alertness, depressing psychomotor function, fatigue, etc. However, a few studies do not support this. Lipsitz in his study found that although neuroleptic use was more common among fallers, but it was not statistically significantly different than non-fallers. Various Vasodilators, NSAIDS, Diuretics, Antihypertensives and Cardio protective medications also act as potentially significant risk factors for falls. Some of the factors, such as sedative use and cognitive impairment, although low in prevalence, were associated with a very high risk of falling.

Impaired ambulation, impaired stepping and mobility and the use of assistive devices all act as significant risk factors associated with falls in the elderly. Tinette believed that balance problems such as unsteadiness in sitting down, standing on one leg unsupported, turning and unsteadiness after a gentle push on the sternum inability to pick up walking pace pose toe potential predisposing factors for falls. Poor general health indicating previous history of fall or injurious fall have strong evidence of being a significant risk factor prediction falls.

Adequate skeletal muscle strength and joint range of motion, especially in the lower extremity, are essential to an effective response to postural perturbations and to the maintenance of postural control. Age related slowing of postural responses increases the muscular force required to mount an effective response to postural disturbances but, at the same time, the strength of skeletal muscles involved in postural control and locomotion declines with age, disease, and inactivity. Weakness of the lower extremity especially at the hip, knee and the ankle, joint and foot problems generally are significant and consistent risk

factors. Weak muscles and unstable or painful joints with reduced range may be a source of postural disturbances during voluntary movement. Decreased ankle dorsiflexion and plantarflexion was identified as a potential risk factor for falls by Studenski(1991).

Age related slowing in the neurological functioning such as slowing of the reaction time, impaired knee or plantar reflexes make the elderly more prone to falls. Inability to compensate for sensory modalities increases with age and contributes to balance failure in the elderly. The elderly group also shows impaired lower extremity sensory function.

Visual deficits are considered to be important determinants of the risk of falls in the elderly. In the prospective study of falls by Tinetti annd colleagues, elderly persons with a impaired vision had a 1.7 fold increased risk of fall compared with little or no near vision imairment, and those with impaired distance vision had a 1.4 fold increased risk of a fall. Nevitt and colleagues similarly found a deficit in distance visual acuity to be associated with a 1.5 fold increased risk of recurrent falls during a 1 year follow-up. Other visual defects such as impaired dark adaptation, double vision, errors in depth perception, cateracts and glaucoma may also contribute to falls in the elderly cohort.

A number of medical conditions, including Arthitis, Demnetia, Stroke and Parkinson's disease may have direct adverse effects on postural control or may affect balance indirectly as a result of physical deconditioning. Although most studies have not found an association of falls with chronic cardiovascular conditions, their role as risk factors has been stated in some studies. Incontinence and postural hypotension (postural or drug induced) have also been recognized as a potential risk factor for falls.

Many falls in the elderly are attributed, at least in part, to environmental factors such as stairs, curbs or clutter. According to Nevitt et al, features of the home that make activities of daily living more difficult are poor lighting, inaccessible storage space, low seats and chairs are potentially important risk factors for falls. Environmental factors are implicated by self report as contributing to one third to one half of falls in community dwelling subjects.

Methods of Identify Falls

Evaluation of balance, particularly standing balance is a major part of routine neurological or medical assessment. It helps to understand how the postural control system works, aids clinical diagnosis and assessment of treatment efficacy. Lastly it can be used to identify elderly people with a history of falls and areas where they are at a risk of falling.

The earliest scientific study of human balance were conducted in 1853 by Romberg who assessed diseases of the Central Nervous System by the amount of sway when the subjects stood with eyes closed.

For a very long time the postural sway measurement was used to assess balance. They focused on abnormalities in postural sway as an indicator of balance disorders and then later progressed to more complex testing of responses under various conditions.

The laboratory measures of assessing balance include The Clinical Test of Sensory Interaction and Balance (CTSIB) and the Limits of Stability Test. These tests are done in some laboratory and require sophisticated and advanced equipment. By the mid 1980's clinical tests for balance started to become more prominent. A large number of clinical tests are developed as no single test can adequately measure all the components of balance. The Berg

Balance Scale, Get Up and Go Test, and The Timed Up and Go Test are few well-known clinical measures of balance. Other two important functionally oriented balance assessment measures are Tinetti Balance Test of the Performance - Oriented Assessment of Mobility Problems and the Functional Reach Test. The Functional Reach Test(FRT) is a dynamic measure of stability during a self-initiated movement.

Katherine O' Berg et al compared clinical balance scales like Berg Balance Scale, Tinetti Balance Test of the Performance- Oriented Assessment of Mobility Problems and the Timed Up and Go Test with laboratory measurements of Balance. She found that clinical functional balance measures were superior to laboratory measures, when measuring basic functional activities rather than measuring the postural sway, because they were more predictive in the functional aspects of the subject.

The Timed Up and Go Test

Description and purpose

This test measures the time it takes for a subject to stand up from an arm chair, walk a distance of 3m, turn, walk back to the chair, and sit down. This test was originally designed by Mathias et al in1986, as a clinical measure of balance in the elderly people and was scored on an ordinal scale of 1 to 5 based on an observer's perception of the performer's risk of falling during the test. While the extremes of the scale, 1 and 5, were easy to score, the intermediate numbers, 2 to 4, were less clear. Podsiadlo and Richardson (1991), modified the original Up and Go test, by timing the task and proposed its use as a short test of basic mobility skills for frail community-dwelling elderly.Reliability, Validity, and Reference Data Intratester and intertester reliabilityhave been reported as high in elderly population (N=10-30) (ICC=.99, ICC[3,1]=.92-.96, C[3,3]=.98). However test-retest reliability of measurements obtained with the TUG in a

group of mainly community -dwelling older adults without cognitive impairments (n=844, age range of total sample [N=2,305]=69-104 years was moderate (ICC[mode not stated]=56).

Construct validity has been supported through correlation of TUG scores with measurements obtained for gait speed (Pearson r=.75,n=40), postural sway (Pearson r=48,n=40), step length (Pearson r=-.74,n=40), barthel index (Pearson r=-.79,n=40), functional stair test (Pearson r=.59,n=20), and step frequency (Pearson r=-.59,n=40). For identifying falls, the TUGT was found to have a sensitivity and specificity of 87%. Ranges of TUGT scores have been reported for various sample of elderly people. In a study by Podsiadlo and Richardson (1991), 10 men and women without known pathology, aged 70-84 years (X= 75 years, S.D not specified), had a mean TUG score of 8.5 seconds (S.D not specified, range=7-10). In a study conducted by Steffen et al , in different age and gender groupings in community dwelling elders showed a mean score of 8 sec (N[males]=15,N[females]=22, S.D.=2), in both males and females of 60-69 age group. In the age group of 70-79, the mean score was 9 sec (N[males]=14,S.D.=3, N[females]=22,S.D.=2) and in age group of 79-80 it was 10 sec (N=8, S.D.=1) in males and 11-sec in females (N=15,S.D.=3).

Berg Balance Scale(BBS)

Description and purpose

The berg balance scale was developed as a performance-oriented measure of balance in elderly individuals. It was designed to be an easy to administer, safe, simple and reasonably brief measure of balance for elderly people. The Berg Balance Scale consists of 14 test items and is scored on a 5-point rating scale ranging from 0-4. A score of 0 is given if the participant is unable to do the task, and a score of 4 is given if the participant is able to complete the task based on the criterion that has been assigned to it. The developers of the BBS

provided operational definitions for each task and the criteria to be representative of daily activities that require balance. They include simple mobility tasks (e.g. tandem standing, turning 360 degree, single leg stance). Some tasks are rated according to the quality of the performance of the task, where as the time taken to complete the task is measured for other tasks.

Reliability, Validity and Reference Data Studies of various elderly population (N=31-101, 60-90+ years of age) have shown high intrarater and interrater reliability (ICC[model not stated]=.98), ratio of variability among subjects to total =.96-1.0, r=.88. Test-retest reliability in 22 people with hemiparesis was also high(ICC[2,1]=.98).

Content validity of the BBS was established in a 3-phase development process involving 32health care professionals who were experts working in geriatrics settings. Criterion-related validity has been supported by moderate to high correlations between BBS scores and other functional measurements in a variety of older adults with disability: Barthel index (Pearson r=.67,n=31), Fugl-Meyer Test motor and balance subscales (Pearson r=.62-.94,n=60), Timed Up and Go Test (TUG) scores (Pearson r=.76,n=31), Tinetti balance subscale (Pearson r=.91,n=31) and the Emory functional Ambulation profile (Pearson r=-.60,n=28)

Several studies have shown that a baseline BBS score contributes to discrimination between elderly people who are prone to falling and those who are not prone to falling although other data have not supported this finding. Riddle and Stratford combined the data Bogle-Thorbahn and Newton and Shumway-Cook et al BBS was relatively poor for identifying people who are at-risk for falling (sensitivity=64%) but relatively good for identifying people who are not at risk for falling (sensitivity=90%).

In a study of inner-city-dwelling older adults, Newton found a mode score of 53 (range= 29-56) on the BBS for 251 subjects aged 60-95 years (Mean=74.3, S.D.=7.9). Increasing age has not been shown to correlate with decreasing BBS scores.

Strategies to Prevent Fall

Researchers have shown that among intrinsic factors, impaired stance balance and mobility greatly increase the probability for falls, fractures, and functional dependency among the older adults. It has been estimated that between 10%and 25% of all falls are associated with poor balance and gait abnormalities. Despite the apparent relationship between impaired balance and increased likelihood for falls among the elderly individuals, studies examining the effects of exercise on improving balance and decreasing risk of falls in this population have mixed results. One possible reason for this inconsistency is the variation in exercise programs utilized in their studies.

Several investigators have examined the effect of a single form of exercise on balance in older adults, with mixed results. Lichtenstein et al reported an improvement in balance following high intensity strength training in older adults. Roberts found that a 6-week program of aerobic walking improved balance among older adults, but changes in falls were ot reported. Brown and Holloszy reported three months of strength and flexibility training. Judge et al found no relationship between balance and resistive training. Hu and Woollacott reported that exercises focusing on improving the organization of sensory information underlying balance control resulted in a decrease in stance postural sway in older adults. Other trials have used a general exercise program aimed at seniors, which may not have been sufficiently specific to be effective.

Single-intervention strategies that have proved effective among elderly persons deemed at risk for falling, either because of the presence of a known risk factor or because of a history of falls, include professionally supervised balance and gait training and muscle strengthening exercise; gradual discontinuation of psychotropic medications; and modifications of hazards in the home after hospital discharge. Cambell et al concluded in their study that tapering and discontinuation of psychotropic medications, including benzodiapines, other sleep medications, neuroleptic agents, and antidepressants, over a 14-week period were associated with a 39%reduction in the rate of falling.

Crilly et al found no improvement in postural sway in 50 older women following a 12-week program of balance retraining. Tinetti et al found a 31% reduction in the rate of fall among community dwelling older adults who participated in a multifocus intervention project that included the use of exercises to improve balance and ability to transfer safety. In the targeted risk factor approach, interventions applied and protocols selected varied somewhat for each individual intervention participant. These interventions included home-based gait, balance, and strength training exercises supervised by a physiotherapist; a medication review by the study nurse, who discussed possible changes with subjects and their physician; transfer-skills training; and home environmental medications.

Province et al used a meta-analysis to examine the effects of exercise on falls and fall-related injuries among seven different facilities participating in the frailty and injuries: Cooperative studies of intervention techniques (FICSIT) study, concluding that exercise reduced the risk of falling by 10%. This relative reduction was statistically significant ($p=0.04$) the largest effect was in those trials that involved balance training (17% relative risk reduction), rather than

strength or endurance training. Province et al, thus concluded that some form of balance retraining appears to be the most effective type of exercise for reducing fall risk. Means et al during there study in 1996 examined the effect of a general balance and mobility exercise program in a pilot study on a65 volunteers. In the year 2005, they carried out a study with 338 subjects which showed the effectiveness of the general balance and mobility exercise program. The program included active stretching, postural control, endurance walking and repetitive muscle coordination exercises starting with a relatively low level of exercise intensity (frequency and repetitions) of the individual exercises and was progressive. Participants were allowed some individual flexibility to progress at a comfortable pace.

Specificity of training is important not only to athletes but also to older people. When exercise mimics functional moves, consistent improvements are seen in most of the functional tasks assessed before and after training. Nitz and Choy(2004) in their study determined the effectiveness of specific balance strategy training programme for preventing falls among older people. They believed that no previous study had investigated the efficacy of a specific balance strategy practice, sensory integration, and added attention demands during function and multi-task practice. Each station task is graded to cater to various levels of ability so that participants can have the level of difficulty progressed to increase the challenge. All participants of the specific balance strategy-training programme significantly reduced the number of falls and functional measures. Thus, concluding that specific balance strategy training using workstation is superior to traditional exercise class for improving function and balance.

In our study we are comparing the effect of specific balance – strategy training and general balance and mobility exercise program on the improvement in balance scores in the community dwelling elders.

III. DESIGN AND METHODOLOGY

This chapter deals with the methods used for this study. These include information on the subjects, instrumentation used and the interventions given.

Sample

A sample of convenience of 70 older adults took part in this study. The subjects were collected through a Geriatric camp organized at Padmavathy College Of Physiotherapy, Periannahalli, Dharmapuri and neighbour hood of the campus also volunteered for the study. Subjects who fulfilled the inclusion criteria and were ready to attend the exercise program regularly were selected.

Inclusion Criteria

1. Age above 65 years
2. Elderly who are community dwellers and not institutionalized or hospitalized.
3. Mini-mental status examination (MMSE) scores above 24.
4. No history of orthopedic surgery.
5. Not dependent on the assistance of another person.

Exclusion Criteria

1. An acute illness that may interfere in the participation for the study.
2. Unstable cardiac condition.
3. No other orthopedic or neurological illness.
4. Permanent history of dizziness.
5. Severe visual deficit.

Research Design

A comparative study design was used in this study.

Instrumentation

1. Chair of 46cm of seating height.
2. Plinths and exercise mats.
3. Standard measuring tape
4. Markers
5. Weighing machine
6. Stopwatch
7. Wooden blocks of various heights
8. Chairs of different heights with and without armrests.
9. Cup and saucer
10. Balls of various size and weight.
11. Foam
12. Shelves of various heights.
13. Mirror
14. Weights (0.5,1,2kg)
15. Bed sheets

Protocol

A sample of convenience of 70 older adults took part in this study. These subjects were then randomly divided into two groups which received different balance training intervention. Group 1 consisting of 35 subjects received Specific balance –Strategy training while Group 2 consisting of 35 subjects received General balance and mobility exercise. Demographic data of the subjects was collected in the demographic data collection form. This included the sex, age, height and the weight. Following this the subjects were assessed on the two balance scales: The Timed up and Go (TUGT)-Appendix C(2) and the Berg Balance Scale (BBS) Appendix C(3). After assessing the

initial balance scores, the specific intervention programme was applied for each group for a period of four weeks with five sessions per week. Each session lased for 25-30 minutes. The same subjects were assessed on the above mentioned balance scales after 4 weeks of training.

Procedure

The subjects were invited to participate in the study. A detailed explanation of the procedure was given after which the subjects signed an informed consent the subjects were assessed on the two balance scales: The Timed up and Go (TUGT)-Appendix C(2) and the Berg Balance Scale (BBS) Appendix C(3). Subjects of Group 1 received the General Balance and mobility exercise program (Appendix D-1) which consists of active stretching and strengthening of the lower limb muscles, postural control exercises, endurance walking and repetitive muscle coordination exercises. This programme initially started with a low level of intensity (low frequency and repetitions) of individual exercises and was progressive over the weeks. The resistance applied, rest period, etc was adjusted individually so that participants could exercise at a subjectively moderate intensity.

Subjects of Group 2 received a Specific balance-strategy training programme (Appendix D-2). A workstation was designed to focus on a specific task that addresses various aspects required for balance including functional strength, flexibility, balance strategy practice, sensory integration, and added attentional demands during function and multi-task practice. Various simple tasks were selected such as sit to stand. This task was practiced using different chair heights, with/ without upper limb assistance, balancing a cup with/ without water on a saucer or while adding a conginitive task to the manual task. Each task was graded to cater to various levels of ability so that participants can have the level of difficulty progressed to increase the challenge.

Timed up and Go Test (Appendis C-2)

The Timed up and go test measures the time it takes a subject to stand up from an arm chair, walk a distance of 3m, turn, walk back to the chair and sit down.

A chair of 46cm of seat height was used for the study. A 3m distance was marked off on the floor in front of the chair. A large board was placed on the mark at the end of the 3m. The test began with each subject sitting, back against the chair, arms resting on the lap and feet just behind the distance-marker on the floor. The subject is allowed to wear his shoes and use his usual walking aid, if any. The subject was instructed that on the word 'go, he should stand up, walk comfortably and safely the board on the floor, walk around the board, come back and sit in the chair. They were informed that the trial would be timed. Timing began with the word 'go' and ended when the subject's back rested against the chair upon returning. A practice trial was performed for all subjects before the recording of scores. This was to make the subject familiar with the procedure. Average of three trials was done and used for data analysis.

Berg Balance Scale (Appendis C-3)

Berg Balance Scale was developed as a performance oriented measure of balance in elderly individuals. It consists of 14 items which are scored on a scale of 0 to 4. A score of 0 is given if the participant is unable to complete the task and score of 4 is given if the participant is able to complete the task based on the criteria assigned to it. The maximum score of the test is 56. Elements of the test are supposed to be representative of daily activities that require balance. They are sitting to standing, standing unsupported, sitting with back unsupported on the floor or on the stool, transfers, standing unsupported eyes

closed. Standing unsupported with feet together, reaching forward with outstretched arm while standing, picking up an object from the floor in standing position, turning to look behind over the left and right shoulders while standing, turning 360^{o}, placing alternate foot on step or stool while standing unsupported with one foot in front and standing on the leg. Scores obtained during the assessment were used in data analysis.

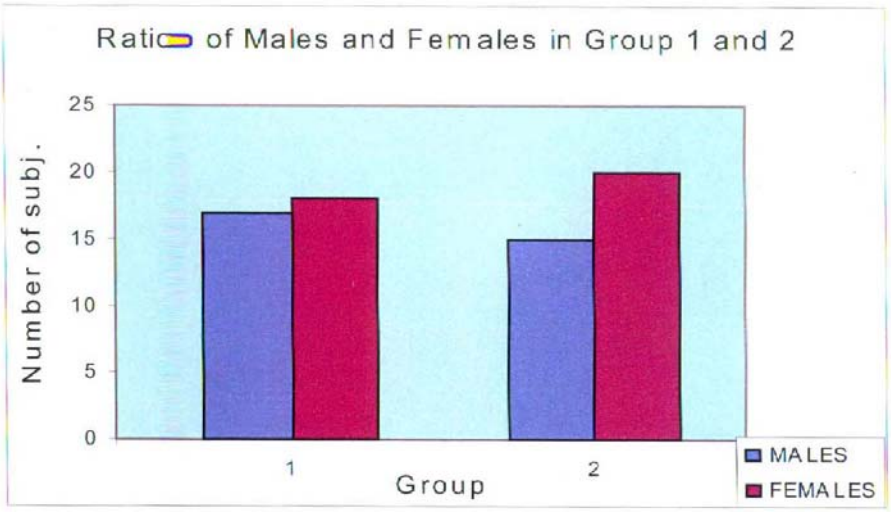
IV. OBSERVATION & ANALYSIS

Statistics were performed using SPSS software.

A student's t-test was used to analyze the difference between the balance improvements in group 1 and group 2. Intragroup analysis between pre-intervention and post- intervention scores was also done for both the groups. A significance level of $p \leq 0.05$ was fixed.

V. RESULTS

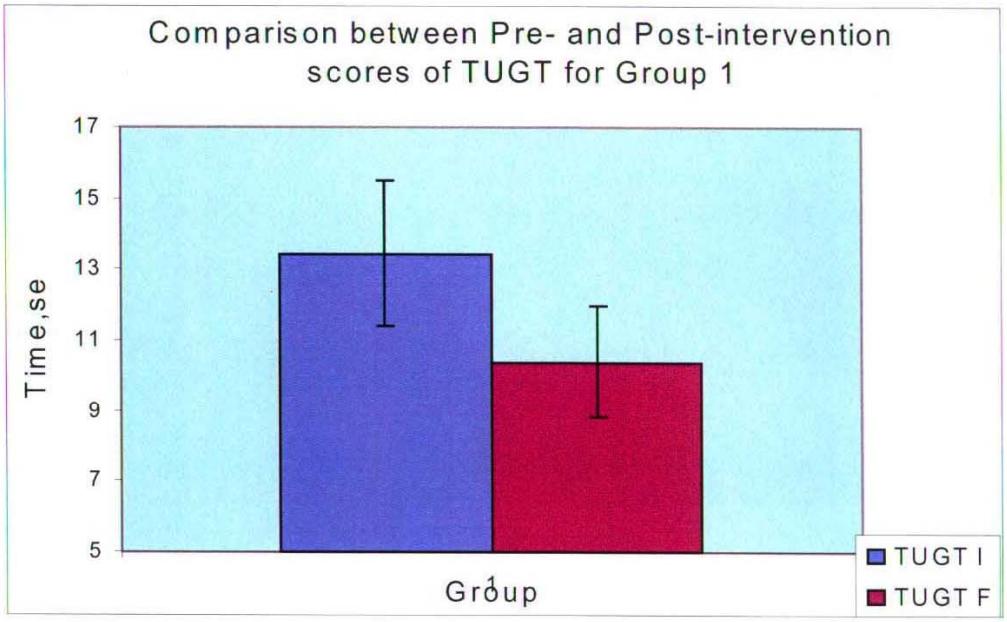
FIGURE 6.1



Group 1: N=35, General Balance and Mobility exercise Group

Group 2: N=35, Specific Balance-strategy Training Group

FIGURE 6.2

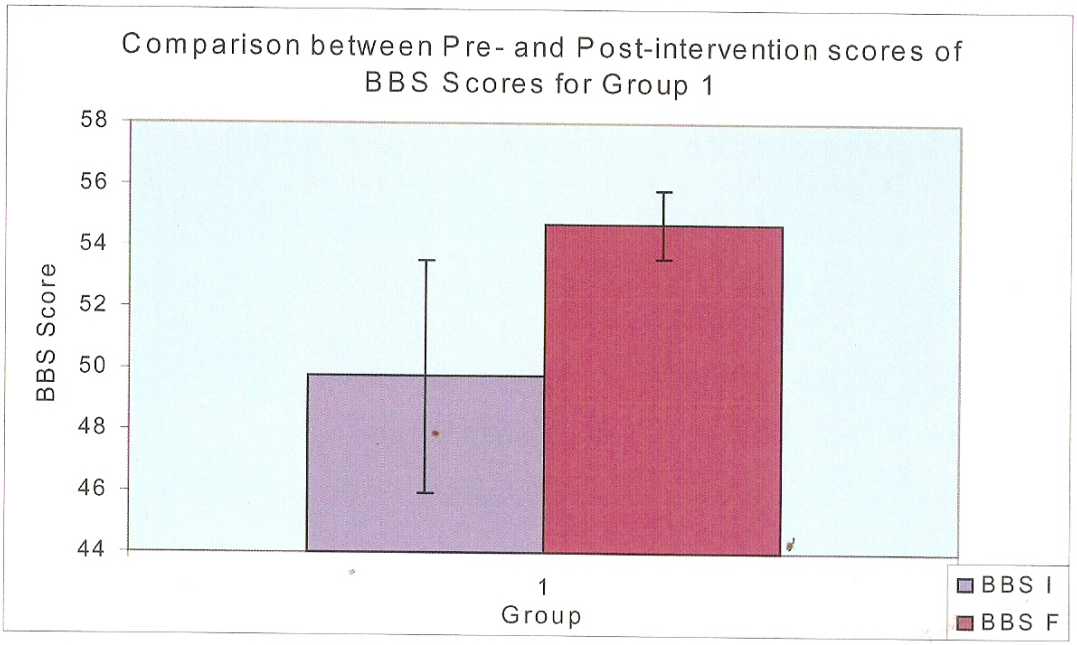


TUGT: Timed Up and Go Test

TUGT I: Pre-intervention scores of TUGT for Group 1

TUGT F: Post- intervention scores of TUGT for Group 1

FIGURE6.3

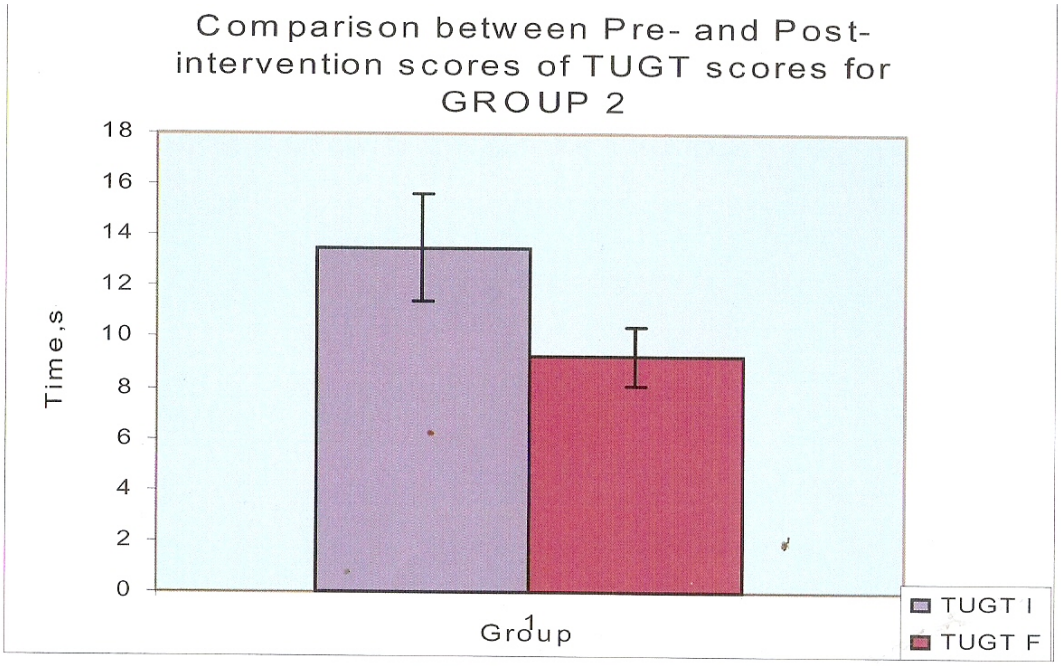


BBS: Berg Balance Scale

BBS I: Pre-intervention scores of BBS for Group 1

BBS F: Post-intervention scores of BBS for Group 1

FIGURE6.4

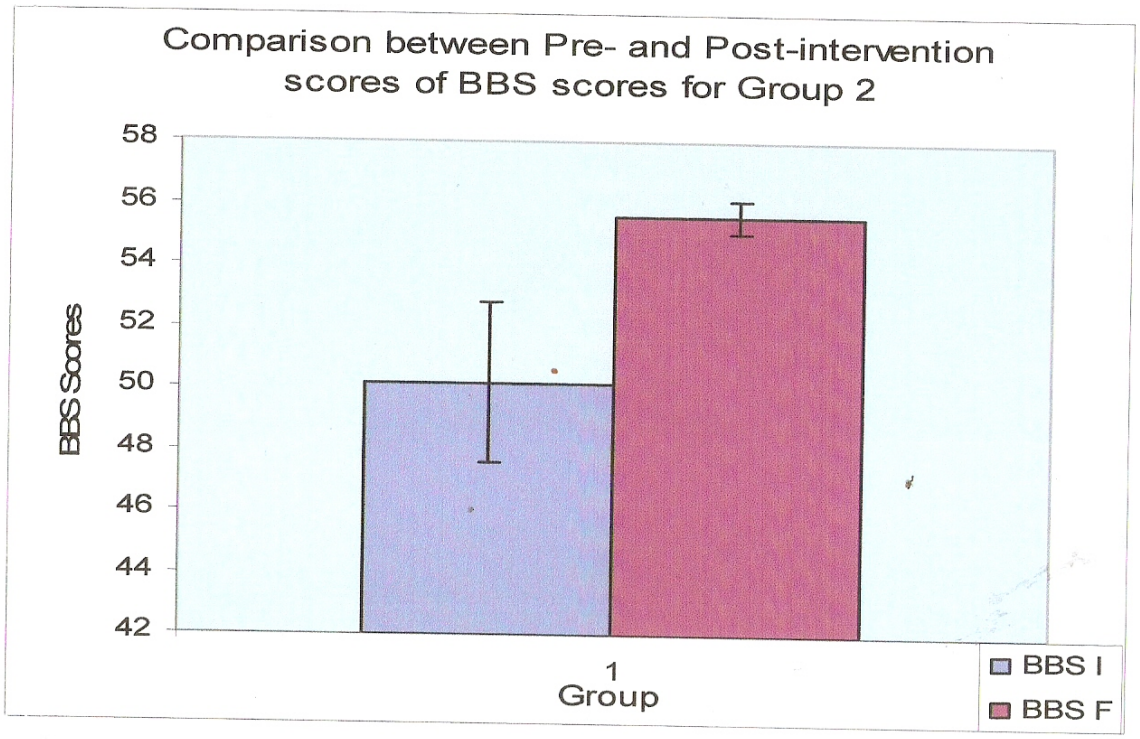


TUGT: Timed Up and Go Test

TUGT I: Pre-intervention scores of TUGT for Group 2

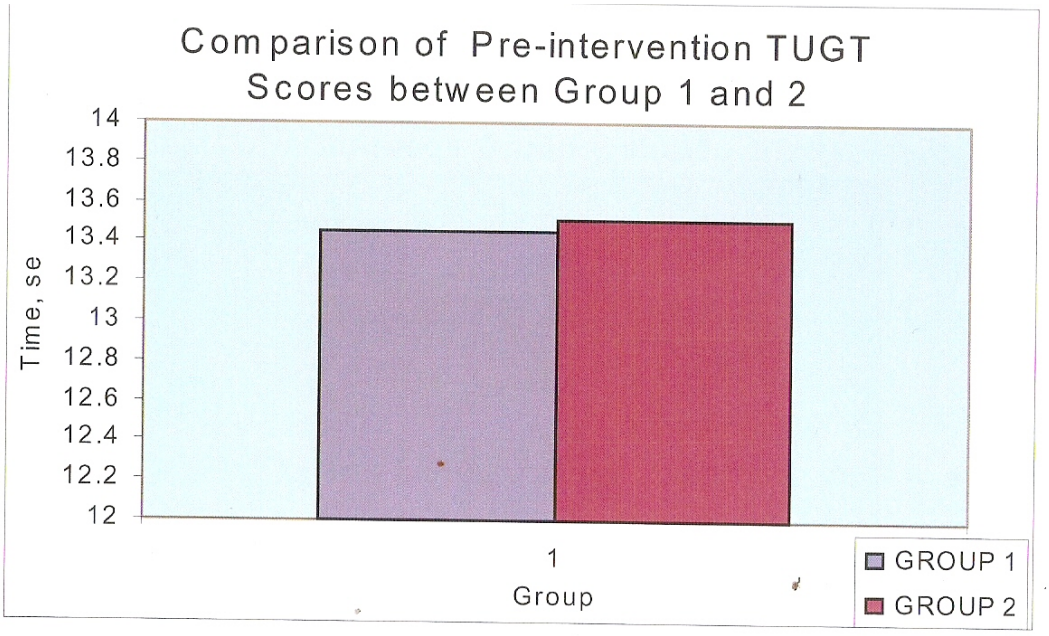
TUGT F: Post- intervention scores of TUGT for Group 2

FIGURE6.5



BBS : Berg Balance Scale
BBS I: Pre-intervention scores of BBS for Group 2
BBS F: Post-intervention scores of BBS for Group 2

FIGURE6.6

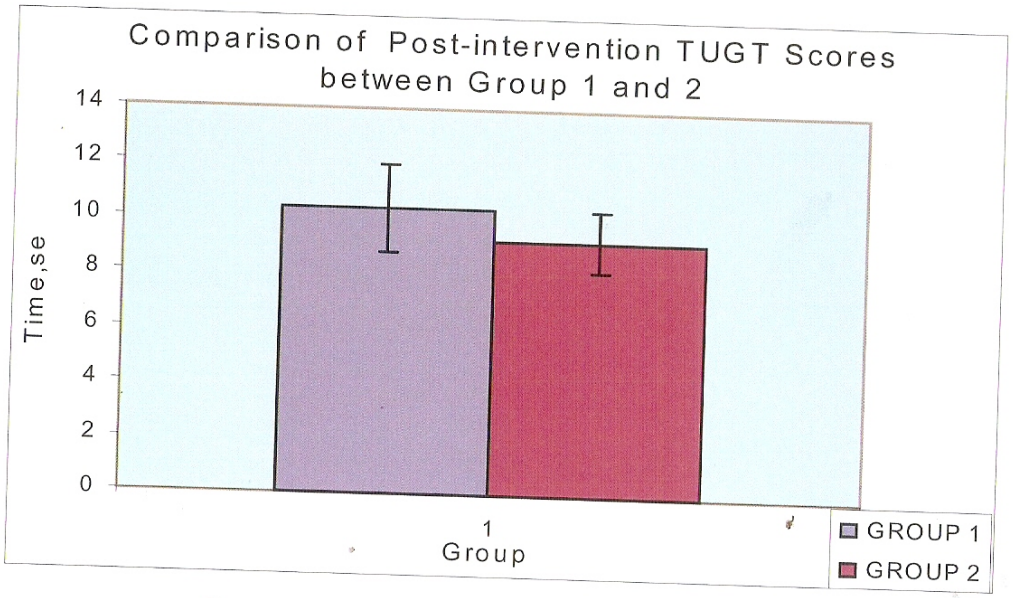


TUGT: Timed Up and Go Test

Group 1: N=35, General Balance and Mobility exercise Group

Group 2: N=35, Specific Balance-strategy Training Group

FIGURE6.7

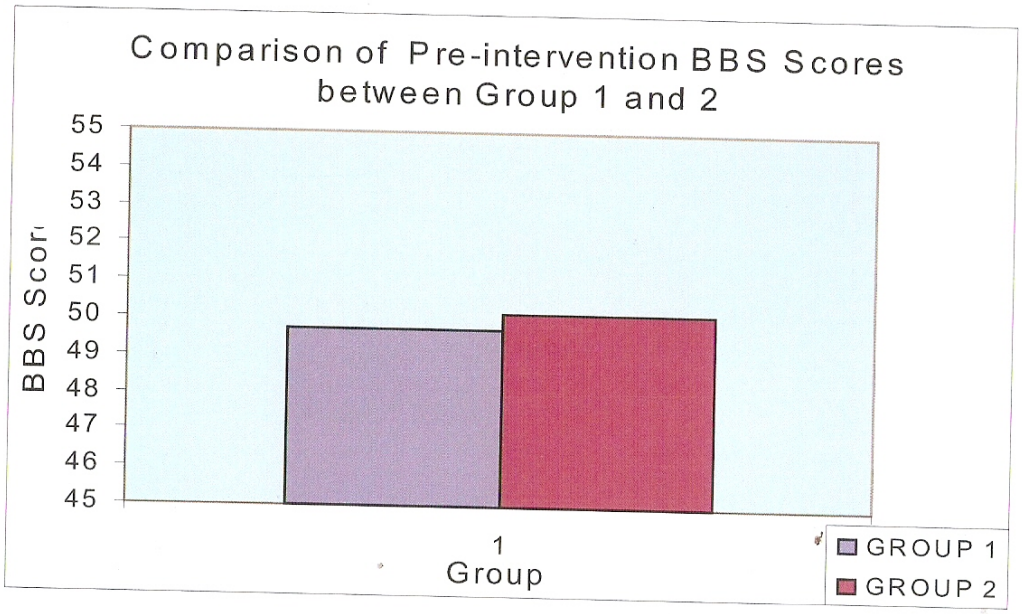


TUGT: Timed Up and Go Test

Group 1: N=35, General Balance and Mobility exercise Group

Group 2: N=35, Specific Balance-strategy Training Group

FIGURE6.8

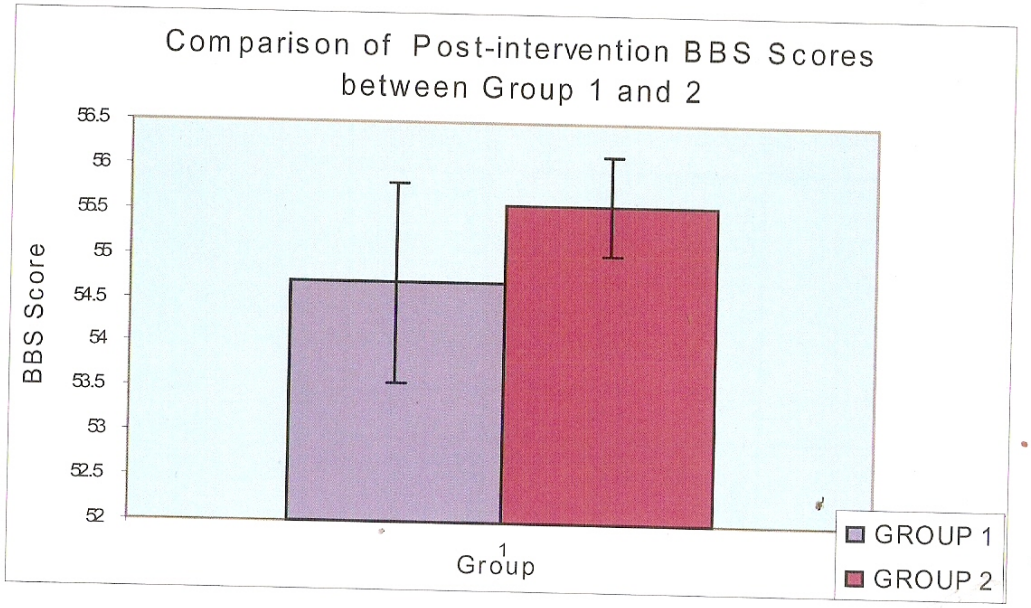


BBS: Berg Balance Scale

Group 1: N=35, General Balance and Mobility exercise Group

Group 2: N=35, Specific Balance-strategy Training Group

FIGURE6.9



BBS: Berg Balance Scale

Group 1: N=35, General Balance and Mobility exercise Group

Group 2: N=35, Specific Balance-strategy Training Group

This chapter deals with the results of the data analysis of the two intervention group scores on the two balance measures.

The group receiving General Balance and mobility exercise program (Group 1) consisted of 17 males and 18 females with a mean age of 69.24 ± 4.30 years while the Group 2 receiving Specific balance – strategy training programme consisted of 15 males and 20 females with a mean age of 69.89 ± 4.23 years. Both the groups were matched in terms of age, height and weight.

A student's t-test was used to compare the performance of subjects of group 1 and 2 on Timed up and go test (TUGT) and Berg balance scale (BBS) prior to the intervention program. The analysis of Pre-intervention scores of TUGT between group 1 (X=13.45, S.D. = 2.04) and group 2 (X=13.51, S.D. = 2.09) did not show any significant difference (t-value = 0.12, p = 0.909) indicating that both groups were matched in terms of TUGT scores. The BBS scores also showed no significant differences between both the groups (Group 1 : X=49.74, S.D. = 3.78, Group x : X = 50.17, S.D. = 2.62) with t-value=0.55 and p=0.583.

The comparison of Post-intervention scores TUGT between group 1 (X=10.38, S.D. = 1.59) and group 2 (X=9.27, S.D. = 1.13) revealed a significant difference with a t-value of 3.35 and p = .001 Subjects in group 2 showed significantly better results on TUGT. This was also seen for BBS scores (Group 1 : X = 54.69, S.D=1.13, Group 2: X = 50.17, S.D. = 2.62) with t-value = 0.55 and p = 0.583.

The comparison of Post-intervention scores TUGT between group 1 (X=10.38, S.D. = 1.59) and group 2 (X=9.27, S.D. = 1.13) revealed a significant

difference with a t-value of 3.35 and p=.001 Subjects in group 2 showed significantly better results on TUGT.

Within the group there was significant difference in the pre-intervention and post-intervention TUGT scores of group 1 (t-value=13.14, p=0.000) and group 2 (t-value= 17.44, p = 0.000) BBS score pre-intervention and post-intervention also showed significant difference for both group 1 (t-value=10.05, p=0.000) and group 2 (t-value=12.90, p = 0.000). Thus, indicating that both the groups showed marked improvement in the balance scores.

Table 1 : Demographic Data : Comparison between Group 1 and 2 (t-test)

Background information	Group 1	Group 2	t-value
Number of participants	35	35	
Age, Yr	69.34 ± 4.30	69.89 ± 4.23	$0.53^{N.S.}$
Height, cm	159.73 ± 9.33	159.49 ± 7.60	$0.12^{N.S.}$
Weight, kg	66.69 ± 6.99	66.29 ± 8.40	$0.22^{N.S.}$
Sex	M = 17 F = 18	M = 15 F = 20	

N.S = NON-SIGNIFICANT

Table 2 : Comparison of Timed up and go (TUGT) and Berg balance scale (BBS) pre-intervention scores between group 1 and 2 (t-test)

Balance Scale	Pre – intervention Scores group 1 (N=35) (Mean ± S.D)	Pre-intervention Scores group 2 (N=35) (Mean ± S.D)	t-value
Timed up and go test (TUGT)	13.45 ± 2.04	13.51 ± 2.09	0.12 N.S.
Berg balance scale (BBS)	49.74 ± 3.78	50.17 ± 2.62	0.55 N.S.

Table 3 : Comparison of Timed up and go (TUGT) and Berg balance scale (BBS)

post-intervention scores between group 1 and 2 (t-test)

Balance Scale	Post – intervention Scores group 1 (N=35) (Mean ± S.D)	Pre-intervention Scores group 2 (N=35) (Mean ± S.D)	t-value
Timed up and go test (TUGT)	10.38 ± 1.59	9.27 ± 1.13	3.35**
Berg balance scale (BBS)	54.69 ± 1.13	55.57 ± 0.56	4.15**

** Significant at 0.01 level

Table 4 : Intra-group comparison of TUGT and BBS scores)Paired t-test)

Balance Scale	Pre – intervention scores (Mean ± S.D)	Post-intervention Scores (Mean ± S.D)	t-value
Group 1 : TUGT	13.45 ± 2.04	10.38 ± 1.60	13.14**
BBS	49.74 ± 3.78	54.69 ± 1.13	10.05**
Group 2 : TUGT	13.51 ± 2.09	9.27 ± 1.13	17.44**
BBS	50.17 ± 2.62	55.57 ± 0.56	12.90**

** Significant at 0.01 level

DISCUSSION

The results obtained reveal that subjects in both the groups: Specific balance -strategy training and the general balance and mobility exercise group benefited from the balance training interventions with a significant improvement in post-intervention Balance scores (Group 1 : p=.000, Group 2: p=.000) as compared to their pre-intervention scores. This can be seen in figures 5.2 to 5.5 and Table 4.

On comparison of Group 1 and Group 2 it was seen that although there was no statistically significant difference between pre-intervention Timed Up and Go Test (TUGT) scores of Group 1 and 2, the post-intervention TUGT scores revealed high level of significance with performance of subjects in Group 2 better than Group 1, Similar results were obtained from Berg Balance scores which showed no statistically significant difference in Pre-intervention scores but the Post-intervention scores showed a highly significant improvement in group 2.

Thus, indicating that those participants receiving the specific balance-strategy training program did better on both outcome measures (Timed up and Go Test and The Berg Balance Scale) than the general balance and mobility training group as seen in figure 5.7 and 5.9, Table 3. One factor that might have contributed to improved scores in the Group 2 participants was the composition of tasks they practiced. These tasks contained elements that encouraged participants to bend, turn and reach to limits of stability (e.g. while playing a game of ball catching and throwing) on various surfaces thereby providing added vestibular stimulation. Such interventions encouraged speed and size of movements which may have increased strength and endurance in addition to improving flexibility and reaction time for the balance group. This

could have resulted in more efficient movement in the improved functional ability to balance, ambulate in the environment and at a faster velocity. Support for this view comes from the improved outcomes from a similar multi-dimensional balance training program delivered as an individual intervention(69) rather than small groups.

On the other hand, the general balance and mobility exercises program also showed significant improvements unlike previous studies of general exercise programs aimed at seniors which did not show significant results[78-80].

The improvement shown in group 1 was less than that shown in group 2. A possible explanation could be that movement to the limits of stability was not an integral component nor were walking on different surfaces, turning and other rotational elements.

Clinical Implications

These data suggest that the Specific balance-training strategy is more effective in improving balance in community-dwelling older adults as compared to the general balance and mobility exercise. This helps us to choose a better balance training program in community-dwelling elderly population above 65 years in order to improve balance significantly even in a short time duration. The ultimate effect of this study is to improve balance with the aim of reducing injurious falls in the fall prone elderly population.

Future Research

This study was conducted for a short period only. Future research involving a longer time period and comparing the effects of the two inventions programs is possible. Also, the research can be oriented towards finding out the

reduction in falls following balance training in either groups. This can be done by maintaining a follow-up for few months to years.

As mentioned earlier, this study uses only a small sample of subjects and that too from the same community. The relevance of this study can be increased by taking a larger sample of subjects from different sectors of the society.

CONCLUSION

This study thus concludes that although both General Balance and Mobility Exercise and Specific Balance-Strategy Training programme showed a significantly better improvement in balance as compared to Group 1.

Thus, concluding that a Specific Balance – Strategy Training Programme is superior to a General Balance and Mobility exercise programme.

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APPENDIX-A

MASTER CHART

GRP	SL	AGE	SEX	HEIGHT	WEIGHT	TUGT 1	TUGT F	BBS 1	BBS F
1	1	77	2	152	65	14.25	12.7	50	54
1	2	66	2	162	53	14.82	10.48	48	55
1	3	70	2	148.5	75	12.98	11.75	50	54
1	4	72	2	145	62	14.37	9.49	49	55
1	5	66	2	158	62.5	14.91	11.31	45	54
1	6	65	2	170	73	13.87	12.81	42	53
1	7	67	2	154	58	10.12	8.14	53	56
1	8	71	1	168	51	12.9	9.25	56	56
1	9	65	2	155	70	11.15	7.92	53	56
1	10	65	2	149	58.5	11.47	9.96	54	55
1	11	67	2	146	67	16.36	10.95	45	54
1	12	67	1	157	67	11.32	8.42	54	56
1	13	78	1	168	73	13.03	11.68	48	53
1	14	66	2	150	65	18.12	12.19	49	53
1	15	65	2	149	63	16.97	11.09	49	54
1	16	73	2	145	71	16.91	12.89	45	53
1	17	67	2	151	63	14.93	11.32	45	54
1	18	70	1	165	65	13.24	9.51	54	56
1	19	69	2	157	69	13.22	11.71	50	54
1	20	72	1	165	63	14.55	9.6	49	55
1	21	77	1	169	67.5	14.25	11.53	50	54
1	22	65	2	154	68	12.69	9.69	53	55
1	23	71	1	155.5	62	11	8.03	53	56

1	24	68	1	169	81	15.12	10.52	50	55
1	25	67	1	164	55	13.84	10.94	45	54
1	26	65	1	176	75	10.12	8.14	53	56
1	27	65	1	172	76	10.15	7.57	53	56
1	28	65	2	154	63.5	13.87	12.81	42	53
1	29	74	2	148.5	67.5	14.83	10.99	47	54
1	30	79	1	166	67	11.45	9.89	53	56
1	31	77	1	169	64.5	14.25	11.53	50	54
1	32	68	1	174	65	9.85	7.88	50	56
1	33	65	1	167	78	13.87	11.86	45	53
1	34	70	1	167	74	13.24	9.51	54	56
1	35	71	1	171	76	12.67	9.22	55	56

GRP	SL	AGE	SEX	HEIGHT	WEIGHT	TUGT 1	TUGT F	BBS 1	BBS F
2	1	65	1	165	85	7.75	6.93	53	56
2	2	65	2	150	63.5	12.56	10.23	53	55
2	3	74	2	148	75	17.85	11.9	51	55
2	4	70	1	170	48.5	12.02	8.16	50	56
2	5	69	1	167	68.5	14.16	9.21	49	55
2	6	65	1	169	70	12	7.51	51	55
2	7	72	1	165	75	16.31	9.49	49	56
2	8	70	2	151	56	18.1	10.21	47	54
2	9	65	1	164	70.5	12.75	9.77	55	56
2	10	68	2	149	74	13.28	8.7	51	55
2	11	67	2	157	66.5	12.56	10.41	53	56
2	12	65	2	148	71	12.97	9.36	48	55
2	13	70	1	163	49	12.09	8	50	56
2	14	65	2	152	65	13	10	54	56
2	15	77	1	164	74	13.75	9.21	53	56
2	16	73	2	157	65	13.17	9.58	47	56
2	17	75	1	166	53	10.86	7.69	48	56
2	18	71	1	166	68	10.31	7.94	55	56
2	19	65	2	152	57	14.83	8.22	55	56
2	20	73	1	169	72	13.07	8.73	48	56
2	21	77	2	152	57	15.26	10.64	50	56
2	22	73	1	169	76.5	14.57	9.53	47	55
2	23	65	2	155	65	14.55	10.49	47	55
2	24	72	1	171	73	16.31	9.49	49	56
2	25	69	2	150	59	13.31	8.75	50	55
2	26	74	2	157	67	17.07	11.56	51	55

2	27	77	2	149	60	12.72	9.13	53	56
2	28	73	2	155	65	12.84	9.49	46	55
2	29	76	1	169	83	11.65	7.93	48	56
2	30	69	1	168	67	14.15	9.2	49	55
2	31	65	2	158	66	12.99	9.12	48	56
2	32	67	1	161	69	11.57	7.93	48	56
2	33	75	2	155	61	15.36	10.66	49	56
2	34	65	2	156	60	13.88	10.01	53	56
2	35	65	1	165	65	12.97	9.36	48	55

Key Words

TUGT 1 – Pre-intervention Scores of Timed Up and Go Test

TUGT F – Post-intervention Scores of Timed Up and Go Test

BBS 1 – Pre-intervention Scores of Berg Balance Scale

BBS F – Post-intervention Scores of Berg Balance Scale

Sex (1) – Male

Sex (2) – Female

Group (1) – General Balance and Mobility Exercise programme

Group (2) – Specific Balance – Strategy Training programme

APPENDIX - B

CONSENT FORM

Padmavathi College of Physiotherapy,
Periannahalli, Dharmapuri.

Title of the Study:

Balance and fall prevention in community dwelling elderly persons – A comparison between effects of specific balance training program and general balance and mobility exercise program.

You are invited to participate in a study, which measures the pre intervention balance scores followed by an exercise protocol of 14 weeks in duration. Your participation is required throughout the period of 4 weeks for 5 days a week. At the end, post-intervention balance scores will be measured using the same outcome measures. You have been invited to participate in the study based on the assumption that you fulfill the inclusion criteria and do not have any orthopedic or neurological illness.

Prior to the participation an investigator will take the medical history to determine whether you have had any major disease, which would make you intelligible to participate. You will be assigned a subject number so that your name will not be associated with any of the findings of the study.

The risk of participation in this study is minimal. I will ensure your safety while doing the procedure. No compensation is available for injuries resulting from participation in this research.

The work also forms a part of the curriculum for the completion of dissertation in master's program in neurological physical therapy. If you have any questions about this study, contact : SHEFALI WALIA at ISIC Institute of Rehabilitation Sciences. Your participation in the study in voluntary, and your decision whether or not to participate will not affect you in any way. If you elect to participate in the study, you have the right to withdraw from the study at any time.

Consent:

1. ……voluntarily consent to participate in this study as described above. I have had a chance to ask questions and was answered to my satisfaction.

Subject's signature

Date : G. KAVIPRIYA

APPENDIX - C

ASSESSMENT SCALES

1. Mini-Mental Status Examination

	Maximum Score	Score	Instructions
Orientation: What is the (year (season) (date) (day) (month)? Where are we: (state) (country) (town) (hospital) (floor)?	5 5	_____	Ask for the date : Then proceed to ask other parts of the question. One point for each correct segment of the question. Ask for the facility then proceed to parts of the question. One point for each correct segment of the question
Registration : Name three objects (bed, apple, shoe). Ask the patient to repeat them.	3	___	Name the objects slowly, one second for each. Ask him to repeat. Score by the number he is able to recall. Take time here to learn the series of objects, up to 6 trials, to use later for the memory test.

Tention and calculation : Count backwards by 7s. Start with 100 stop after 5 calculations. Alternate question : Spell the word " world " backwards	5 5	_____ _____	Score the total number correct. (93, 86, 79, 72, 65) Score the number of letters in correct order. (dlrow = 5 dlrow = 3)
Recall: Ask for the three objects used in question 2 to be repeated	3	_____	Score one point for each correct answer (bed, apple, shoe)
Language: 1. Naming: Name this object (watch, pencil) 2. Repetition: Repeat the following "No ifs, ands or buts."	2 1	_____	Hold the object. Ask patient to name it. Score one point for each correct answer.

3. Follow a 3-stage command: "Take the paper in your right hand, fold it in half, and put it on the floor"	3	_____ _____	Allow one trial only. Score one point for correct answer. Use a blank sheet of paper Score one point for each part correctly executed.
4. Reading: Read and obey the following : Close your eyes. 5. Write a sentence 6. Copying : Copy this design	1 1 1	_____ _____ _____	Instruction should be printed on a page. Allow patient to read it Score by a correct response. Provide paper and pencil. Allow patient to wrote any sentence. It must contain a noun, verb, and be sensible All 10 angles must be present Figures must interest Tremor and rotation are ignored.

TOTAL SCORE: _____ (Max.30) Test is not timed

2. Timed Up and Go

The total time taken by the subject to perform the prescribed task was noted using a stopwatch.

3. Berg Balance Scale

1. Sitting to standing

   Instructions: Please stand up, try not to use your hands for support.

   ( ) 4 able to stand without using hand and stabilizes independently.

   ( ) 3 able to stand independently using hands.

   ( ) 2 able to stand using hands after several tries.

   ( ) 1 needs minimal aid to stand or stabilize

   ( ) 0 needs moderate or maximal assist to stand

2. Standing unsupported

   Instructions: Please stand for 2 minutes without holding

   ( ) 4 able to stand safely 2 minutes

   ( ) 3able to stand 2 minutes with supervision

   ( ) 2able to stand 30 seconds unsupported

   ( ) 1need several tries to stand unsupported 30 seconds

   ( ) 0 unable to sand 30 seconds without support

3. Sitting with back unsupported but feet supported on floor or on a stool

   Instructions: Please sit with arms folded for 2 minutes.

   ( ) 4 able to sit safely and securely 2 minutes

   ( ) 3 able to sit 2 minutes with supervision

   ( ) 2 able to sit 30 seconds

   ( ) 1 able to sit 10 seconds

4. Standing to sit

Instructions: Please sit down

( ) 4 sits safely with minimal use of hands

( ) 3 controls descent by using hands

( ) 2 uses back of legs against chair to control descent

( ) 1 sits independently, but has uncontrolled descent

( ) 0 needs assistance to sit

5. Transfers

Instructions: Arrange chairs for a pivot transfer. Ask patient to transfer one way toward a seat without armrest and one way toward a seat with arms. You may use two chairs or a bed / mat and a chair.

( ) 4 able to transfer safely with minor use of hands

( ) 3 able to transfer safely with definite need of hands

( ) 2 able to transfer with verbal cuing and / or supervision\

( ) 1 needs one person to assist

( ) 0 needs two people to assist or supervise to be safe

6. Standing unsupported with eyes closed

Instructions : Please close your eyes and stand still for 10 seconds

( ) 4 able to sand 10 seconds safely

( ) 3 able to stand 10 seconds with supervision

( ) 2 able to stand 3 seconds

( ) 1 unable to keep eyes closed for 3 seconds but stands safely

( ) 0 needs help to keep from falling

7. Standing unsupported with feet together

Instructions : Place your feet together and stand without holding

( ) 4 able to place feet together independently and stand safely 1 minute

( ) 3 able to place feet together independently and stand with supervision for 1 minute

( ) 2 able to place feet together independently but unable to hold for 30 seconds

( ) 1 needs to help to help assume the position but can stand for 15 seconds, feet together

( ) 0 needs to help to help assume the position and unable to stand for 15 seconds

8. Reaching forward with outstretched arm while standing

Instructions: Lift arm to 90^{o}. Stretch out your fingers and reach forward as far as you can. (Clinician places rules at the tips of the outstretched fingers-subject should not touch the ruler when reaching.) Distance recorded is from the fingertips with the subject in the most forward position. The subject should use both hands when possible to avoid trunk rotation.

( ) 4 reach forward confidently 20-30 cm (10 inches)

( ) 3 can reach forward safely 12 cm (5 inches)

( ) 2 can reach forward safely 5 cm (2 inches)

( ) 1 reaches forward but needs supervision

( ) 0 loses balance when trying, requires external support

9. Pick up object from the floor from a standing position

Instructions: Pick up the shoe slipper which is placed in front of your feet

( ) 4 able to pick up the slipper safely and easily

( ) 3 able to pick up the slipper but needs supervision

( ) 2 unable to pick up the slipper, but reaches 2-5 cm (1-2 inches) from thes lipper

and keeps balance independently

( ) 1 unable to pick up and needs supervision while trying

( ) 0 unable to try/needs assistance to keep from losing balance/falling

10. Turning to look behind over your left and right shoulders while standing Instructions:

Turn and look directly behind you over toward the left shoulder. Repeat to the right.

Examiner may pick an object to look at directly behind the subject to encourage a

better twist.

( ) 4 looks behind from both sides and weight shifts well

( ) 3 looks behind one side only, other side shows less weight shift

( ) 2 turns sideways only but maintains balance

( ) 1 needs close supervision or verbal cuing

( ) 0 needs assistance while turning

11. Turn 360^0

Instructions: Turn completely around in a full circle, pause, then turn a full circle in the other direction.

( ) 4 able to turn 360 degrees safely in 4 seconds or less

( ) 3 able to turn 360 degrees safely, one side only, 4 seconds or less

( ) 2 able to turn 360 degrees safely, but slowly

( ) 1 needs close supervision or verbal cuing

( ) 0 needs assistance while turning.

12. Place alternate foot on step or stool while standing unsupported

Instructions: Place each foot alternately on the step stool. Continue until each foot

has touched the step stool 4 times.

( ) 4 able to stand independently and safely and complete 8 steps in 20 seconds

( ) 3 able to stand independently and complete 8 steps > 20 seconds

( ) 2 able to complete 4 steps without aid with supervision

( ) 1 able to complete > 2 steps need minimal assistance

( ) 0 needs assistance to keep from falling / unable to try

13. Standing unsupported one foot in front

Instructions: (Demonstrate to subject). Place on foot directly in front of the other. If you feel that you cannot place your foot directly in front, try and step far enough ahead that the heel of your forward foot is ahead of the toes of your other foot. (To score three points, the length of the step should exceed the length of the other foot and the width of the stance should approximate the subject's normal stance width.)

( ) 4 able to place foot tandem independently and hold 30 seconds

( ) 3 able to place foot ahead of the other independently and hold 30 seconds

( ) 2 able to take a small step independently and hold 30 seconds

( ) 1 needs help to step but can hold 15 seconds

( ) 0 loses balance while stepping or standing

14. Standing on one leg

Instructions : Stand on one leg as long as you can without holding

( ) 4 able to life leg independently and hold > 10 seconds

( ) 3 able to life leg independently and hold 5 > 10 seconds

( ) 2 able to life leg independently and hold = or > 2 seconds

( ) 1 tries to lift leg unable to hold 3 seconds but remain standing independently

( ) 0 unable to try or needs assistance to prevent fall

_____ TOTAL SCORE (Maximum = 56)

1. Group 1 – General Balance and Mobility exercise programme

Timing	**Activities**
Week 1	Flexibility exercises (5 receptions, 15 sec hold) • Hamstring stretch • Gluteus maximus and hip flexor stretch • Gastrocnemius and soleus stretch Strengthening exercises – lower lime muscles (1 set of 8-10 reps for each leg) • Quadriceps (sitting and straight leg raises) • Hamstrings • Gluteus Maximus • Gluteus Medius
Week 2	Flexibility exercises (as above) Strengthening exercises (as above) Postural exercises (10 repetitions, 10 sec hold) • Trunk (Back Extension) Coordination exercises • Reciprocal leg movements (10 reps, eyes closed) • Bridging (10 reps) • Sitting / Standing (5 reps)

Week 3	Flexibility exercises (5 reps, 20 sec hold) Strengthening exercises (2 sets of 10 reps) Postural exercises (15 reps, 10 sec hold) Coordination exercises (repetitions increased)
Week 4	Flexibility exercises (5 reps, 25 sec hold) Strengthening exercises of lower limb (2-3 sets of 10 repetitions) Postural exercises (20 repetitions, 10 sec hold) Coordination exercises (repetitions increased)

2. Group 2 – Specific balance – strategy training programme

Timing	Response targeted	Progressing the challenge
• Sit to stand to Sit	Lower limb strength Functional ability Multiple tasks	Lower the height of the chair +/- upper limb assistance Hold an item in the hands, balance a cup +/-water on a saucer/tray. Add a cognitive task to the manual task
• Stepping in all directions (forwards, side and back)	Choice step reaction time Lower limb strength and coordination	Use a mirror to provide visual feed back, increase speed of step Perform stepping on a soft surface, close eyes
• Reaching to limits of stability	Challenging limits of stability Vestibular stimulation and integration Upper and lower limb strengthening	Stick objects on a wall in the front by reaching to limits in all directions up and down while keeping feet in one position Lunge forwards to pick up objects that are shifted to a high shelf to the side and behind, progress by reaching further and increasing the weight and size of objects.

• Step up and down	Lower limb strengthening and endurance Step reaction time	Step up forwards, backwards and sideways over blocks of various heights, increase height, repetitions and speed of stepping
• Ankle, hip and upper limb balance strategy practice	Lower limb strengthening Balance strategy training	Stand in front of a wall with toe touching a line ½ meter from the wall. Lean back towards the wall keeping balance and dorsiflexing feet and using arm movement to balance while lowering towards the wall.
• Sideways reach task	Medio-lateral muscle strengthening in lower limbs Vestibular stimulation and integration Challenging of stability Multiple tasks and confounded proprioceptive input	Stand between a high and low table positioned on either side, pick up objects from one table and transfer to other table. Move the tables further apart and increase weight and size of objects to increase challenge The participant undertakes the task standing on an exercise mat on the floor
• Ball games	Multiple taks Hand eye coordination Vestibular stimulation Ballistic upper and lower limb activity	Use inflated beach balls and progress to smaller or harder balls or 2 or 3 balls at once Add a cognitive task such as nominating an animal that starts with a 'G', while throwing and catching or kicking the ball

APPENDIX - D

DATA COLLECTION FORM

Group Number : _____

Subject Number

1. Name
2. Age
3. Sex
4. Address
5. Occupation
6. MMSE Scores

Pre-intervention Scores		Post-intervention Scores	
TUGT	BBS	TUGT	BBS
1. 2. 3. Avg.		1. 2. 3. Avg.	

APPENDIX - E

SAMPLE DATA ANALYSIS

Student's t-test for comparison of Pre-intervention scores of Timed Up and Go Test
(TUGT I) between Group 1 and Group 2

Group	Number of Cases	Mean	Standard Deviation	Standard Error	t-value	Degrees of freedom	2 – Tail Prob
Group 1	35	13.4486	2.043	.345	.12	67.97	.909
Group 2	35	13.5054	2.090	.353			